

## **Visceral Pain Sensation**

### **INTENDED LEARNING OBJECTIVES (ILOs)**

By the end of this lecture the student will be able to:

- ✓ Identify characteristics of visceral pain.
- ✓ List the causes of visceral pain
- ✓ Define referred pain
- ✓ Identify examples of referred pain
- ✓ Explain mechanisms of referred pain

**Definition:** It is a slow type of pain that arise from the viscera.

### **Visceral nociceptors:**

Visceral pain receptors (free nerve ending) are few in most of the viscera, so localized damage e.g. (sharp cut in the viscera does not produce pain). However, widespread inflammation, ischemia, mesenteric stretching, or spasm or dilatation of hollow viscera produce pain.

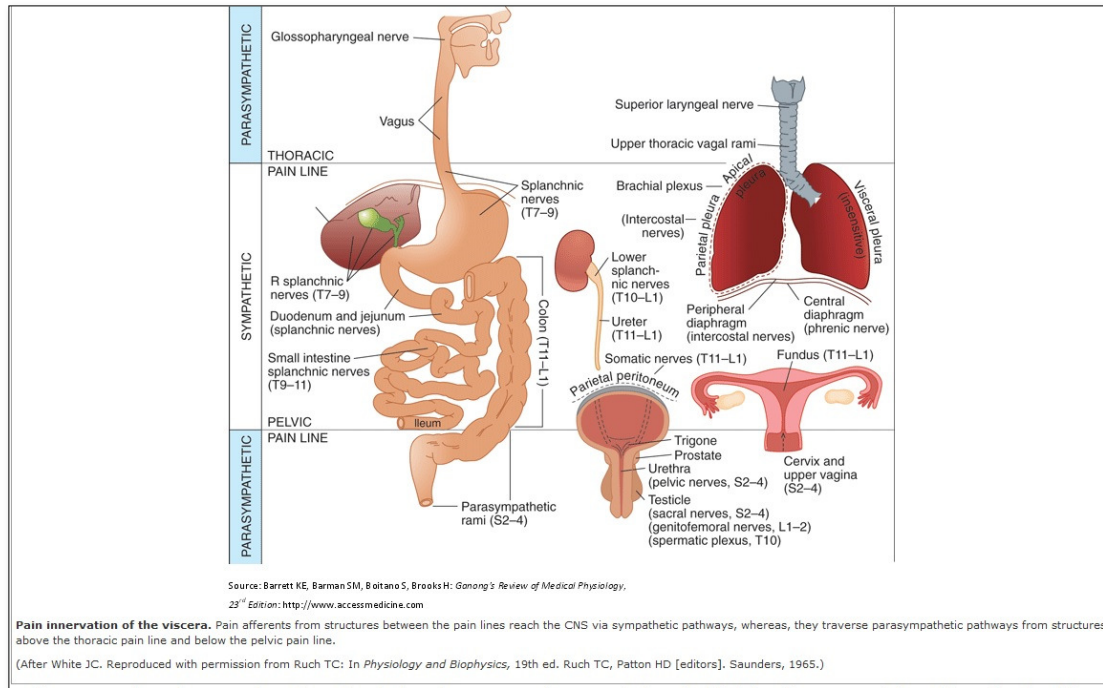
Some viscera are pain insensitive

- Liver parenchyma.
- Lung alveoli.
- Bone.
- Brain.
- Visceral layer of peritoneum, pleura and pericardium.

### **Neural pathway.**

Visceral pain (true) sensation is carried by **unmyelinated type C afferent fibers** in the sympathetic (from most of the viscera e.g. thoracic, abdominal and pelvic viscera e.g. **stomach, spleen, small intestine, colon, kidney, ureter, upper part of urinary bladder, ovary and uterus**) and in the parasympathetic (**from pharynx, larynx, trachea and upper part of esophagus and many pelvic viscera e.g. rectum, prostate, urethra, cervix and upper part of vagina**) nerves. Their cell bodies are located in the dorsal roots and the homologous cranial nerve ganglion. In the central nervous system, visceral pain fibers travel along with somatic pain fibers in the lateral spinothalamic tract.

When a disease affects a viscus spreads to the parietal peritoneum, pleura, or pericardium, patient will feel sharp localized pain as the parietal surfaces, like the skin, are supplied with extensive pain innervation from the peripheral spinal nerves and this called **parietal pain**.



## Common causes of visceral pain are:

1. **I**schemia, as occurring in thrombosis. Pain is due to acidic metabolic end products or tissue degenerative products such as bradykinin and proteolytic enzymes
2. Over-distension of hollow viscera, e.g. intestinal distension in intestinal obstruction, urinary bladder distension in urinary obstruction. Pain is due to stimulation of mechanical pain receptors, and **i**schemia due to compression of the blood vessels by the distended viscera.
3. Spasm of hollow viscus: Pain is caused due to mechanical stimulation of pain endings and **i**schemia. For example, pain due to colics of alimentary, biliary or urinary tracts.

Often pain from a spastic viscus occurs in the form of cramps, with the pain increasing to a high degree of severity and then subsiding. This process continues intermittently, once every few minutes. The intermittent cycles result from periods of contraction of smooth muscle. Each time a peristaltic wave travels along an overly excitable spastic gut, a cramp occurs.

4. **I**nflammation of the viscera, e.g. appendicitis, cholecystitis, pancreatitis.
5. Chemical **i**rritation: Damaging substances may leak from gastrointestinal tract into the peritoneal cavity, e.g. gastric acid leaking through perforated gastric or duodenal ulcer. Which causes widespread digestion of the peritoneum, stimulating wide areas of pain fibers. The pain is usually excruciating.

**Characteristics of visceral pain are:**

- Slow pain conducted by C nerve fibers transmitted to the higher centers through paleospinothalamic tract
- Diffuse (poorly localized), because pain receptors in viscera are comparatively few.
- Dull aching pain.
- Associated with:
  - **Autonomic symptoms** in the form of nausea, vomiting, profuse sweating and lowering of blood pressure and heart rate. As the pain afferent fibers travel in sympathetic and parasympathetic pathways. Thus, visceral pain causes autonomic changes
  - Reflex contraction of skeletal muscle of abdominal wall over the inflamed viscera "**guarding rigidity**". It is especially observed, if the inflammatory process that produces pain also involves the peritoneum and is a protective mechanism that prevents further injury to the viscera and decrease the pain sensation.
  - **Emotional** manifestation in form of depression.
  - **Referred** to another site.

**Referred pain.**

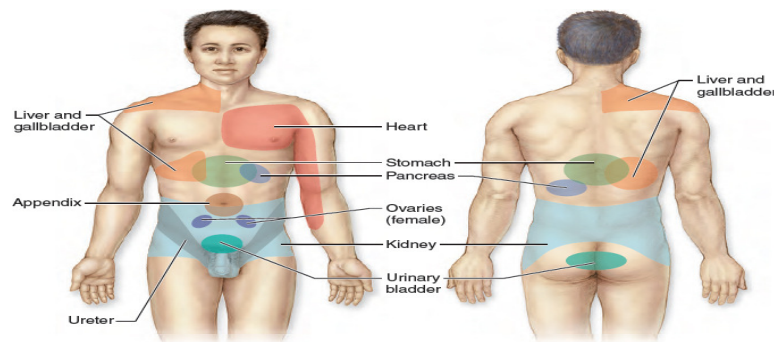
**Definition:** Referred pain is that pain which originates due to irritation of a visceral organ and is felt **not** in the organ but in some other somatic structure (usually skin) supplied by the same neural segment (**pain felt away from its original site**).

Because the skin is topographically mapped and the viscera are not, the pain is identified as originating on the skin and not within the viscera.

Pain is usually referred to a structure with common embryonic origin and hence is innervated by a common neural segment. This principle is called the **dermatomal rule**. For example, embryologically, the heart and the left arm have the same segmental origin. Similarly, the testes and kidney develop from the same primitive urogenital ridge.

Later when the disease process spreads e.g. to the parietal peritoneum which is supplied with extensive pain innervation from the peripheral spinal nerves the Pain will be of the sharp type and localized directly over the irritated peritoneum where the inflamed viscus touches or is adherent to the abdominal wall (**parietal pain**).

## Examples of referred pain are:



[http://textflow.mheducation.com/figures/1259116115/mck54615\\_1605\\_lg.jpg](http://textflow.mheducation.com/figures/1259116115/mck54615_1605_lg.jpg)

- In **myocardial ischemia**, pain is referred to the **left shoulder and the inner side of the left arm**.

As the heart originated in the neck and upper thorax, so the heart's visceral pain fibers pass upward along the sympathetic sensory nerves and enter the spinal cord between segments C3 and T5 and these skin areas are supplied by the same somatosensory nerve fibers (C3 to T5) so cardiac pain is referred to these areas. The pain is usually on the left side because the left side of the heart is much more frequently involved in coronary disease.

- Pain from **gall bladder** referred to the **tip of the right shoulder**.

In cholecystitis, the inflamed gall bladder irritates the diaphragm, which stimulates the phrenic nerve. Therefore, cholecystitis pain radiates to the tip of the shoulder, as the shoulder and diaphragm develop from the same dermatomal segments.

- Pain from **appendicitis** referred to **umbilical area**.

Pain impulses pass first from the appendix through visceral pain fibers located within sympathetic nerve bundles enter the spinal cord at about T10; this pain is referred to an area around the umbilicus. As the inflammation spreads to the parietal peritoneum the pain become sharp and directly over the irritated peritoneum in the right lower quadrant of the abdomen where the inflamed appendix touches or is adherent to the abdominal wall.

- Pain from **kidney** is felt in the **back and radiate as ureter to the corresponding testis and inner thigh**.

As the testes and kidney develop from the same primitive urogenital ridge.

- Pain from **pancreas** will be referred to the **back**.

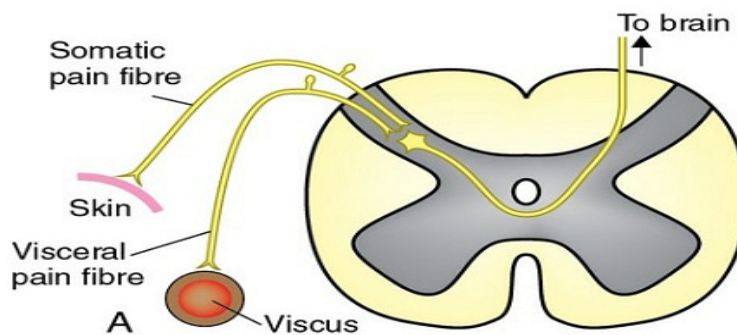
- Pain from **stomach** referred to **epigastric** region.

The stomach originated approximately from the seventh to ninth thoracic segments of the embryo. Therefore, stomach pain is referred to the epigastrium which is supplied by the seventh through ninth thoracic segments.

## Theories of referred pain are:

### 1. Convergence projection theory:

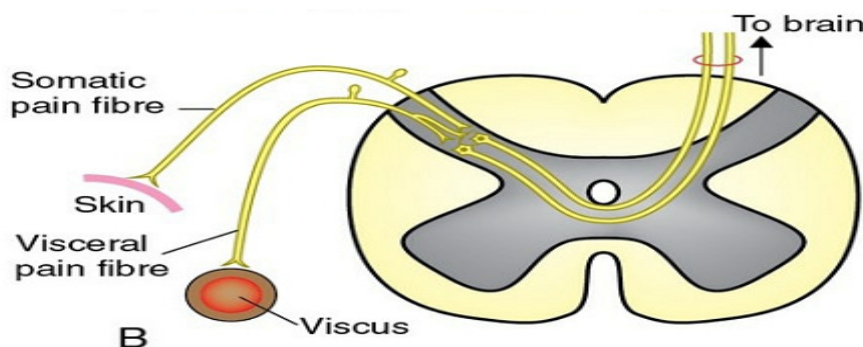
According to this theory, the afferent pain conducting neuron from a somatic area and a visceral organ **converge** on a common second-order neuron in the paleospinothalamic tract. In this way pain impulse from viscera travel in the same central pathway as pain impulse from skin to reach the same final sensory area. Since brain accustomed to receive the pain usually from the skin, the brain **projects** all pain as somatic pain even when the source is actually visceral.



Textbook of Medical Physiology, SECOND EDITION, Indu Khurana, MD, 2015, Elsevier

### 2. Facilitation theory:

According to this theory, the visceral irritation is inadequate for producing pain by itself. However, it facilitates pain fibers from somatic structures, so that even minor somatic irritation produces perceptible pain.



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**SUGGESTED TEXTBOOKS**

1. Ganong's Review of Medical Physiology, twenty-fifth edition 2016, McGraw-Hill Education, chapter 8, from page 159 to 175.
2. Guyton and Hall textbook of medical physiology, thirteenth edition 2016, Elsevier, chapter 49, from page 626 to 628.